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SOVIET INDUSTRIAL DEVELOPMENT

NO. 15

SELECTED TRANSLATIONS

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Introduction

This is a serial publication containing selected translations on industrial development in the Soviet Union. This report consists of a translation of an article entitled "Organization of Labor in the Automation of Petroleum Extraction."

Organization of Labor in the Automation of Petroleum Extraction

Following is a translation of an article by A. Smirnov in Byulleten' Nauchnoy Informatsii -- Trud i Zarabotnaya Plat (Bulletin of Scientific Information -- Labor and Wages), No. 1, January 1960, pages 10-16.

In recent years automation has been introduced in the oil fields of the petroleum industry, through remote control of the operations of oil-field equipment.

The need for introducing automation in oil fields is caused by the difficulty of servicing oil wells and various production facilities spaced considerable distances apart (500-800 meters).

The round-the-clock servicing of oil-field operations, which are dispersed over large areas, requires a large staff of operators, fitters, electricians, and other tending personnel. A large amount of time is expended by oil-field workers in traveling from one object to another, as well as in delivering the necessary materials to the oil wells. To increase labor productivity, cut the extraction cost per ton of crude, and elevate the level of production, it was necessary to automate maximally the process of oil extraction.

In view of the considerable diversity of the geological characteristics of petroleum deposits (terrain relief, methods of extraction, types of operating wells, and forms of drilling equipment), a great deal of time was needed to determine the optimal way of solving this problem. After lengthy investigations it was decided that the over-all automation of all processes should be the principal trend.

Over-all automation is based on the installation in wells and other oil-field structures of automatic devices and means of their connection with the dispatcher's station, and on the organization of the dispatching service as well. Such a system ensures not only constant communication with the oil well tending personnel and supervision of their activities but also the possibility of a partial guidance of oil-well operations from the dispatcher's station.

The automation of oil fields, while facilitating operations and elevating the level of production, has required the introduction of a new structure of the management of oil fields and the perfection of the organization of labor.

Prior to the introduction of automation the organizat-

ion of labor on oil fields was based on the team-sector principle. Every sector of an oil field had its own integrated team of workers concerned with the activities pertaining to the exploitation, study and underground repair of sector wells. In addition, specialized subdivisions servicing all sectors (geological, for repairs of ground equipment and facilities, for pumping crude, etc.) were maintained on the oil field.

However, such an organization of labor had many shortcomings, and as a result the labor of the basic workers -- the operators concerned with petroleum extraction -- was utilized very inefficiently. For instance, photographs of a typical working day on the oil fields of the "Starogrozneft'" (Checheno-Ingushskiy Sovnarkhoz) and the "Bavlyneft'" (Tatarskiy Sovnarkhoz) showed that the operators engaged in the basic production operations for not more than 35 percent of their working time and expend the remaining time on auxiliary operations and on traveling from one object to another. A single operator was able to service only two or three wells, so that as a result the staff of operators was very large. For example, on the oil fields of the "Starogrozneft'" operators accounted for 48 percent of all workers. A similar situation existed with regard to the underground-repair workers, who belonged, on the majority of oil fields, in the composition of the petroleum-extraction teams.

In measure with the introduction of automation and the organization of dispatcher service on oil wells and other facilities (cistern pool, pump stations, boiler stations, etc.), the drawbacks of the old organization of labor had become particularly noticeable. The dispatcher at a central control station began not only to control the performance of oil wells and devices but also to execute, by means of electronics, radio engineering and telemechanics, many production operations previously conducted by operators personally tending the oil wells. This has introduced vital changes into the activities of the basic production personnel of oil fields. The need for periodic personal tours of oil wells was dispensed with. The personal tours of oil wells began to be conducted only when so indicated by the dispatcher, mainly in the case of breakdowns or defects in the installed automatic devices and basic equipment.

The character of the planning of underground repairs has also changed. Now the need for any repair is determined by the dispatcher on the basis of an investigation of the state of wells and underground equipment. This has improved the scheduling of operations, and at the same time it has begun to ensure a substantial reduction in the total number of repairs.

The activities of operators with regard to the investigation of oil wells have also changed. Previously this group of workers had to carry out the complex whole of such activities, and it was not always able to cope with it. As a result, oil wells not infrequently used to operate according to technically unjustified technological regimes.

The conduct of the principal oil-well investigations, e. g., dynamo-metering, by remote control from the dispatcher's station, has curtailed substantially the volume of work of the operators and it has enabled them to devote more attention to the investigations necessary for developing efficient modes of oil-well operation and of the exploitation of oil-bearing strata.

The retention of the system of oil-extraction teams and sectors after the centralization of the control and guidance of operations had led to a situation in which workers had two bosses (the sector head or team foreman and the dispatcher). As a result, the personal responsibility of workers had declined and the conduct of the specialization of labor (which automation makes expedient) and the materialization of various organizational and technical measures on the oil field had become more difficult.

All this attested to the necessity of altering drastically the structure of the management of production and modifying greatly the organization of labor in oil fields. The related reforms were conducted with an active participation of the collectives of the norming and research stations of the oil industry boards of the sovnarkhozes.

The integrated teams and sectors were abolished and replaced by the dispatcher and technological service and, as well, by the services of supervision of ground equipment, underground repairs, supervision of means of automation, etc. These specialized services conduct all oil-field operations.

The make-up and tasks of the services are determined in every individual oil field according to its concrete conditions. Thus, the dispatcher service conducts observations and control of the performance of oil wells and coordinates that performance with the performance of other industrial objects as well. It directs the conduct of various geological-engineering measures ensuring the normal performance of all industrial objects and a steady increase in the extraction of petroleum. The duties of the dispatcher service include also the conduct of work on the guidance of oil wells, regulation of the activities of the services for the underground repair of wells and for the supervision of ground activities, immediate notification of all other services in the event of any stoppages or breakdowns occurring during the exploitation of oil wells and other industrial objects,

and the conduct of all the necessary paper work concerning the performance of the oil wells and of the oil field as a whole.

The dispatcher service also supervises the technological service. The latter service conducts long-range investigations of oil wells and strata to detect their potential possibilities, drafts and conducts various geologic-engineering measures for increasing oil extraction, introduces efficient modes of oil well operation, controls the proper exploitation of oil-bearing strata, studies and operatively utilizes current and archival documentation, etc.

Before the establishment of the dispatcher service and the introduction of automation, the problems of perfecting the technology of oil extraction were partly a concern of the department of the main oil field geologist and of the oil-extraction teams. However, being preoccupied with work on the operative servicing of oil wells, they could not devote adequate attention to these problems.

With the widespread use of means of automation, the oil-field technological service serves as the principal assistant to the dispatcher service in the cause of the struggle for increasing oil extraction. Thus, at the "Andizhan" Oil Field (Fergana Oil Combine), thanks to an improvement in the performance of the technological service, the inter-repair period of oil well operation was doubled in duration while the number of underground repairs dropped from 250-300 to 120-130 a month. This had enabled the collective of that oil field in 1958 and in the first half of 1959 to extract additionally about 10,000 tons of oils from the same wells. Many wells had converted to the economically more expedient periodic exploitation according to especially drafted graphs. The technological service on the oil fields of "Bavlyneft!" (Tatariya') had developed a more efficient regime of deposit exploitation which has resulted in not only increasing the extraction of oil from strata but also substantially cutting the related costs.

As for the services of ground equipment supervision and of underground repair, these assure a stoppageless performance of the ground and underground equipment of oil wells. Previously the related work was fulfilled by oil-extraction teams. Upon the introduction of automation the operational conditions of these teams had become greatly altered. This is attested, e. g., by the working-time balance of the operators from oil-extraction teams, whose functions have now been transferred to the operators of the ground equipment supervision service. Data obtained on the basis of photographs of the typical working day in Groznyy, Tatariya, Bashkiriya, Central Asia, and other oil regions before and after automat-

ion are surveyed in Table 1.

Table 1

Type of Operation	Percentile Share in Total of Operations	
	Before Automation	After Automation
Preparatory Operations	7.0	6.1
Travel from Object to Object	33.6	17.2
Basic Operations (Inspection, Preventive Repair, Start-Up of Equipment)	24.3	59.3
Stoppages and Rest Pause	10.7	6.0
Auxiliary Operations	24.4	11.4

Thus, under the new conditions the share of the time of conduct of basic operations has climbed from 24.3 to 59.3 percent, while the loss of time on moving from one object to another and on auxiliary operations has declined from 58 to 26.8 percent. The improvement in the utilization of the working time of operators has created the conditions for reducing the personnel in this category of workers.

Thus, e. g., on the oil fields of the "Bavlyneft" in 1955-1956 one operator used to service three or four wells, while after the introduction of automation he began to service 8.2 wells on the average and, in certain cases, even as many as 12-14 wells.

The average number of operators per worked well-month in 1955 amounted to 1.22 persons, whereas in 1958 it declined to 0.70 persons. The expenditure of the working time of operators per 100 extracted tons of petroleum has declined from 15.2 man-hours in 1955 to 8.1 man-hours in 1959. The extraction of petroleum per operator per year during the same period has climbed from 16,600 to 26,500 tons. This increase in labor productivity was achieved thanks to a drastic reduction in the expenditure of time on the servicing of the wells.

The changes in the expenditure of time on the servicing of one gusher well with forced pumping of oil from the measuring tank, before and after automation, are reflected in

Table 2.

Table 2

Time Element	Before the Introduction of Automation		After the Introduction of Automation	
	Total (in man-hours)	In Which: Observation of the Per- formance of Equipment	Total (in man- hours)	In Which: Observation of the Per- formance of Equipment
Work on the Servicing of:				
Deparaffinizing Facility	46.7	1.0	3	3
Gusher Reinforcement	3.0	0.25	3	0.25
Ladder	1.25	1.25	1.25	1.25
Measuring Tank Pump	1.25	1.25	1.25	1.25
Miscellaneous Operations (Replacement of Rig Tube, Preparation of Territory, etc.)	32.0	30.0	1.5	1.5
Travel from Well to Well	10.6	--	10.6	--
Rest Pause, 10 percent	11.0	11.0	8	8
	10.6	4.5	3	1.6
Total	116.4	49.25	31.6	16.85

It can be seen from the above table that the most laborious operations are those concerned with the servicing of the deparaffinizing facility and the pumping of crude from the measuring tanks which, before their automation and telemechanization, used to require considerable outlays of labor whereas now these outlays have been nearly totally dispensed with. The outlays of the labor of operators on the conduct of the other operations pertaining to the extraction

of petroleum have also decreased substantially.

The conduct of these operations now merely requires one tour of the well in the daytime. This has resulted in reducing the outlays of time on not only the travel from one well to another but also on the conduct of preparatory and concluding operations.

As a result of automation and telemechanization the servicing time per oil well with forced out-pumping of petroleum has been reduced by 5.8 man-hours a day, i. e., by over 77 percent, and per oil well without forced out-pumping -- by 3.33 man-hours a day or by 67.4 percent.

The introduction of automation required the establishment of a service for supervision of means of automation, to be concerned with maintaining the efficient performance of the devices and mechanisms installed in the wells, and repairing them. This supervision service is headed by the dispatcher on duty. However, the organization of such services should be provisional in character. Upon an increase in the qualifications of operators for servicing oil wells through the acquisition of the habits of working with automation, the servicing of ground equipment and of means of automation will be combined. This will make it possible to abolish this special service later on.

Thus, the fundamental trend in the organization of labor on oil fields upon the centralization of operational control on the basis of a broad introduction of automation is the specialization of operations coupled with a mandatory expansion of the working functions of every worker. The specific character of the repair, investigatory and other operations on oil fields, the use of new and intricate apparatuses and equipment, and the introduction of new modes of oil-well performance as well, all pose higher requirements to the qualifications of workers, and this engenders the need for providing workers with a broad training background so as to enable them to ensure the normal operations of the oil field as a whole with the least outlays of time and effort.

Upon the automation of production the workers with a broad training background will combine the closely interrelated operations. For instance, the operator servicing the ground equipment of oil wells will at the same time also tend to the means of automation in the wells, the operator servicing the cistern pool will at the same time attend to the means of automation in cisterns, etc. This requires a more efficient organization of the work on the training of workers through regular courses and on special seminars.

The centralization of control operations and the introduction of automation on oil fields create a need for changing also the work schedules. Previously, oil fields operated,

as a rule, in three shifts. Despite the comparatively limited volume of operations in the evening and night hours, the oil fields employed many operators and repair workers who toured the wells and inspected the performance of equipment. Under the conditions of telemechanization all these functions are fulfilled by the dispatcher. As a result, it is no longer necessary to employ workers for the second and third shifts. During the evening and night hours the only personnel present in addition to the dispatcher are two or three operators and a few fitters for conducting the unpostponable operations. The execution of this measure has made it possible to reduce the numbers of the labor force without thereby lowering the quality of the exploitation of oil wells.

The transition to the one-shift working regimen has been carried out on the automated oil fields of Groznyy, Central Asia, Tatariya, and Azerbaydzhan. In every case, despite the greater complexity of the conditions of well exploitation (greater depth, curving of a major part of the rig shaft, intensive plug and paraffin formation), the abolition of second and third shifts has justified itself fully.

The conduct of the above-described measures was taken into account by the norming and research stations when drafting the norms for the numbers of servicing personnel under the conditions of single-shift operation, and it has made possible the relieving of a considerable number of workers. For instance, 46 workers in the basic skills were relieved at Oil Field No. 1 of the "Starogrozneft'" (See Table 3).

Table 3

Type of Skill	Number of Workers	
	Before Reorga-nization	After Reorga-nization
Well-Investigating Operators	11	5
Ground-Equipment Supervisors	84	48
Underground Repair Workers	51	47
in which: Repair Teams	41	37
Preparatory Teams	10	10
Total	146	100

Experience indicates that the reform of the organization of labor and production in oil fields should be conducted upon taking into account the concrete conditions and methods of exploitation of every individual deposit. In this connect-

ion, different oil fields may maintain different groups of services, or too specific working skills may be introduced. Only one fundamental principle should be common to all oil fields, to wit: rejection of the sector-team type of the organization of labor, and maximal centralization of operational control coupled with a complete specialization of operations.

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